MORPHOLOGY OF CARPELLARY SCALES IN LARIX.

BY THOMAS MEEHAN.

THE facts which I have from time to time contributed, verbally or in papers, to the Academy, in regard to longitudinal series of axillary buds, and adnated and free leaves in coniferous plants, will, I believe explain something of the structure of the flowers of coniferæ, which, if not quite distinct from any view before taken, will at least have reached the conclusion by an original line of argument.

I have shown that in the cases where there are longitudinal series of buds, one of the buds, and generally the upper supra-axillary one, is the largest. So far as this longitudinal series of buds is concerned, I find by extensive observation that there are very few of our American trees or shrubs which do not produce them under some circumstances, although they are more generally apparent in some than in others. In many cases they do not break quite through the cortical layer, but continue to grow from year to year, just as the wood grows, always remaining just under the outer bark. It is from these concealed but living buds that the flowers of the *Cercis*, or the spines of *Gleditschia*, will often appear from trunks many years old. In *Magnolia* and *Liriodendron* these concealed buds are easily detected by a thin shave of the outer bark with a sharp knife. In very vigorous shoots of the latter, a series of two—one supra-axillary—is not rarely found prominently above the bark. In many cases one of these buds, usually the lower, and really axillary one, never pushes into growth. In *Gymnocladus* neither upper nor lower would probably ever push, only for the fact that it matures no terminal bud, and thus the laterals have to renew the next season's growth. But for this, *Gymnocladus* would go up like a palm, or, more familiarly, as *Aralia spinosa* does, without a single branch. Failing in the terminal, but two laterals push, giving the branches their dichotomous character. The two which push are always the upper ones in the series of 2, 3, or 4, which appear in this species.

The purpose of this duplication of axillary buds will interest

all who study this part of Botany. I find that they are not for the duplication of parts, but are separately organized from one another. Thus, in *Cratgæus* and *Gleditschia*, the upper bud produces a spine, the lower is organized to grow as an axillary shoot the next season. But the best illustration of the distinctive organization is in those cases where both upper and lower buds sometimes push the same season, as in *Itea*, *Lonicera*, *Caprifolium*, or *Halesia*. Here we find that one is organized for floral organs, and the other for axillary prolongation. The upper bud always has the same function, and the lower its own, in the same species.

A flower being a modified branch, in which the bract is the leaf and the peduncle the axillary bud, it follows that the laws of axillary stem-production will be more or less reproduced in the inflorescence.

Referring now to my paper on *Adnation in Coniferæ*, we found that the true leaves of many genera in this order were adnate to the stem, forming what some botanists have termed *pulvini*, or cushions, under the fascicles of some species of *Pinus*, and that what are commonly called leaves, the "needles," are really phylloidal shoots. An examination of *Abies excelsa* will show that the upper portion of the needle has a different origin from the lower adnated portion, or pulvinus, and that in all probability it is a modification of the phenomenon referred to in *Gymnocladus*, and other plants, of a longitudinal string of buds, in which the upper is of a different organization to the lower one. In *Larix* it was shown that in the verticils, or perhaps more properly spurs or clusters, the true leaves were free, while in the elongated axis they became for most of their length adnate with the stem, forming the spathulate scales we find peel off the two-year-old wood.

At the flowering time of the Larch, the male and female flowers proceed from the termination of the spurs—not merely "of the preceding year," according to *Gray's Manual*, but in some cases of many preceding years, "the sterile from leafless buds, the fertile mostly with leaves below." (*Gray's Manual*, 5th ed., p. 472.) Why have the female flowers leaves under them, and the male none? Comparing the male and the female catkins, we see why. The scales of the male are formed out of the leaves which become fully formed in the female one. The pair of anther cells are thus simply on the back of a transformed leaf, just as we find the spore-cases of ferns borne in the same way. The weaker organization which I have

shown in my paper, and communications on sex, permits no further development here. But in the case of the female flower the leaf maintains a separate organization all through the catkin or cone; and, as shown in my paper on the *Stipules of Magnolia*, the midrib of the leaf shortens, and, assuming a stipular character, increases in width, until we have the purple bractea so well known in Larix. As soon as these bractea have been arrested in their development, the carpellary scales, which answer to the phylloidal fascicles of *Pinus*, commence their growth in most species of Larch, finally equalling the bracts in length.

Whether or not the ovules which appear in the axis of the carpellary scales again result from a third longitudinal bud, I have no evidence; what I have proposed to myself in this paper is simply to show that *the scales in the male catkin of Larix are modified true leaves; while in the female they arise from buds of another organization, being the morphologized secondary leaves, or phylloidal shoots as I term them, of other coniferous genera.*